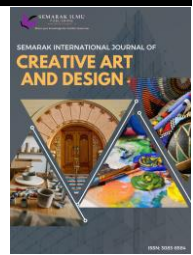




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The Ayer Muleh Sculpture

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ABSTRACT

The Ayer Muleh sculpture is an innovative and symbolic design that represents the School of Design (SDe), inspired by the traditional Ayer Muleh motif, which symbolizes continuity and adaptability. The sculpture features a spherical light, a magnetized surface for attaching notes, and integrated drawer compartments for storage. Unlike previous designs, it includes a button-operated light system instead of a sensor. The finishing incorporates elegant gold accents with a striking purple base to enhance its visual appeal. The design process involved thorough benchmarking, concept development, and the successful fabrication and testing of the prototype. This sculpture not only serves as a functional piece but also as an artistic representation of creative identity and thoughtful design innovation within the academic environment.

1. Introduction

The aim of this project is to design and develop a functional tabletop sculpture that embodies the identity and creativity of the School of Design (SDe) at Universiti Teknologi Brunei (UTB). More than a decorative object, the sculpture is intended to serve both artistic and practical functions, symbolizing the values of UTB's Product Design program while integrating elements of Melayu Islam Beraja (MIB) a philosophy central to Brunei's national identity.

This initiative seeks to merge aesthetic expression with functional innovation, resulting in a product that resonates with UTB's design ethos. By incorporating features such as motion-activated lighting and the use of sustainable materials, the sculpture aligns with contemporary trends in user-centered and eco-conscious design. Its target users include students, educators, and design professionals who value creativity, utility, and cultural symbolism in their workspaces.

Inspired by the evolving role of sculpture, from static monuments to interactive and experiential forms, the design takes cues from modern functional sculptures that emphasize interactivity, spatial storytelling, and multi-sensory engagement. Such practices demonstrate how sculptures today are not only physical artifacts but immersive experiences shaped by narrative and technology [1].

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The challenge is to create a functional tabletop sculpture that seamlessly integrates artistic expression and practical functionality. The sculpture must:

- i. **Combine dual-purpose design:** Must function as both an artistic piece and a practical item. It should also seamlessly combine aesthetics and utility.
- ii. **Represent cultural identity:** Symbolize Sde, UTB's values and optionally include MIB elements.
- iii. **Address usability constraints:** Fit within a tabletop setting without overwhelming the workspace and be practical for daily use in academic or academic or creative environments.
- iv. **Integrate modern technology:** Include features such as motion-activated lighting, ensuring the design is innovative and aligned with contemporary trends.
- v. **Promote sustainability:** Use eco-friendly materials to reflect modern values of environmental responsibility.

To achieve this vision, the project follows a systematic design process: beginning with problem identification and user research, followed by concept ideation, iterative development, and concluding with the construction of a functional prototype.

2. Literature Review

Functional sculpture merges artistic aesthetics with practical utility [2][3]. Embedding cultural values in design enhances user connection[4], and sustainable approaches are increasingly vital [5][6]. Emotionally durable products foster longer-lasting user relationships [7], while user-centered design ensures practical functionality [8][9]. In Brunei, integrating Melayu Islam Beraja (MIB) values helps preserve cultural identity [10], and the adaptation of traditional Malay motifs to modern design is a growing trend [11]. These perspectives guide the sculpture's cultural and functional dimensions.

3. Market Research, Benchmarking & Survey

The research phase focuses on understanding user needs, identifying market trends and analyzing existing functional sculptures to inform the design of versatile, culturally meaningful and practical tabletop sculptures. This analysis provides valuable insights into functionality, design styles and cultural representation which are crucial to develop an innovative and user-friendly product.

3.1 Market Research

3.1.1 Functional sculpture

Functional sculpture refers to a form of art that serves a practical purpose or functional use while also being aesthetically pleasing and artistically designed. Unlike traditional sculptures that are primarily decorative or symbolic, functional sculptures blend art with everyday utility.

3.1.2 Dual purpose

Combines artistic expression with practical functionality. Examples include furniture like chairs, tables or lamps designed with artistic flair.

3.1.3 Innovative design

Often features unique, creative designs that transform ordinary objects into work of art.

3.1.4 Material diversity

Can be made from a variety of material, including wood, metal, glass, ceramic and even recycled materials.

3.1.5 Usability

Despite their artistic appearance, functional sculptures are designed to be used, offering both form and function Interaction: Encourages user interaction, making art part of everyday life.

3.1.6 Functional art trends

- i. Integration of technology (e.g. motion sensors, augmented reality) is increasingly popular, enhancing user interaction and utility.
- ii. Sustainability is a key focus with eco-friendly materials like reclaimed wood and recycled materials.
- iii. Minimalist aesthetics emphasizing clean lines and simple forms dominate modern functional art.

3.1.7 Target audience needs

- i. Students and professionals prioritize desk organization, ergonomic design and multi-functionality.
- ii. Culturally meaningful designs incorporating local heritage resonate strongly with Bruneian users.

3.2 Benchmarking

3.2.1 Products analysis

Table 1 shows the product analysis for the project.

Table 1			
Product analysis			
	Bearbrick	Kaws figure	Liquid Metal (BlankedStudios)
Price	1	1	0
Aesthetic	3	2	3
Functions	0	0	0
Size	3	3	3
Interactivity	1	1	2
Total Points	8	7	8
Score	1	2	1

3.2.2 Observation

While popular designer figures like Bearbrick offer strong branding appeal, their functional value remains low, as critiqued in consumer culture literature [12].

3.3 User Survey Insights

3.3.1 Primary functions

- i. 60% of respondents preferred desk organizers, followed by lamps (20%) and pen holders (13%).
- ii. Users value multi-functional designs combining storage and lighting.

3.3.2 Design preferences

- i. 53% preferred modern and minimalist styles with 20% favouring traditional cultural elements.
- ii. Popular colours: Purple, gold and yellow, reflecting UTB and MIB values.

3.3.3 Technological features

Motion-activated lighting was the most appealing feature (60%), followed by augmented reality and temperature sensors.

3.3.4 Challenges with existing products

Lack of multi-functionality, difficult to clean, bulky design and poor ergonomics were common issues.

3.4 Key Insights for Design

The sculpture should prioritize desk organization as its main function, combining features like storage compartments and motion-activated lighting. A modern, minimalist design with cultural elements (e.g. Malay patterns, Islamic geometry) will resonate with users.

The ideal size is 20 – 30 cm, compact enough for tabletops but large enough to serve as a centerpiece. Materials should be sustainable (e.g. wood, metal) to align with user preferences and functional art trends.

4. Concept Development

The concept development phase focuses on translating user preferences, market trends and cultural insights into design ideas for functional tabletop sculpture. Using moodboards and sketches, multiple concepts were made, emphasizing multi-functionality, modern aesthetics and cultural representation.

4.1 Concepts

Using moodboard and inspiration board as guides, three initial design concepts were developed, each emphasizing functionality, aesthetics, and cultural symbolism:

4.1.1 Concept 1

Inspired by Simpup fruit as shown in Figure 1, it features petal-shaped compartments and motion-activated light. It is made of wood painted with purple and yellow. The size is compact as it is only around 10-20 cm. The Simpup is a national symbol of Brunei, emphasizing unity and growth.



Fig. 1. Concept 1

4.1.2 Concept 2

Simpup-shaped lamp with base acting like a pen holder as shown in Figure 2. The leaves function as additional pen holders, made of plastic and metal. The lamp is adjustable, sensor-activated and it is around 30 cm high. The sculpture represents innovation and practicality.

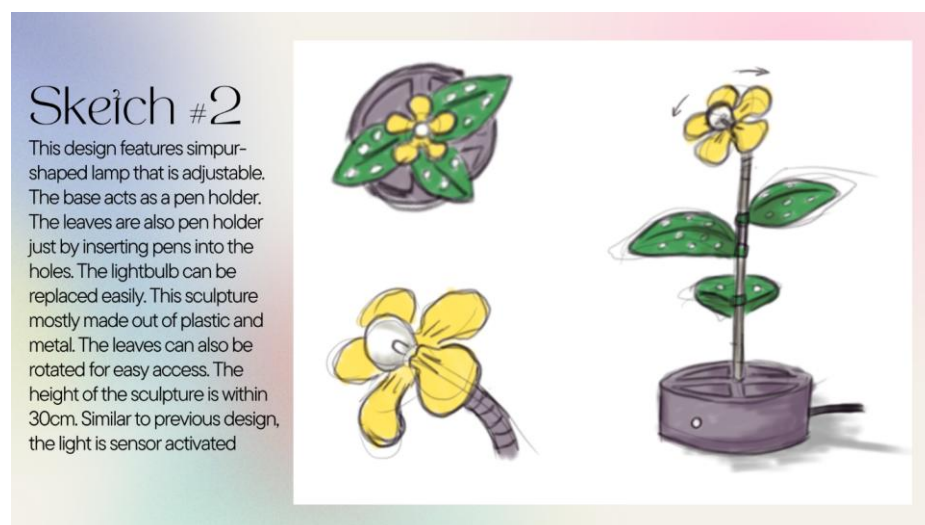


Fig. 2. Concept 2

4.1.3 Concept 3

Ayer Muleh-inspired design with spherical light as shown in Figure 3, magnetized surface for notes and drawer compartments for storage. Unlike the two designs, it has a button to switch on the light instead of sensor. The finishing has gold accents with the base coloured in purple. The Ayer Muleh symbolizes continuity and adaptability.



Fig. 3. Concept 3

4.1.4 Concept 4

Incorporating AJ's head wearing a traditional headwear as shown in Figure 4, called "Dastar" or "Tanjak", into the main design, swapping his face into a multi-functional screen or display that can tell time, date & temperature of the room.

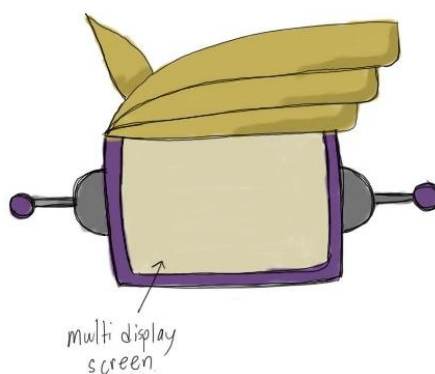


Fig. 4. Concept 4

4.1.5 Concept 5

Inspired from Bearbrick with purple "Cara Melayu", yellow or gold "Dastar" and "Sinjang" as shown in Figure 5, it features the head and hands as lamps. It also has a wireless charging feature on its arm. To add to the interactivity for the user, the arms can be moved to be posed.



Fig. 5. Concept 5

4.1.6 Concept 6

Using the UTB mascot as the main base form and adding traditional Malay headgear with the face being a multi-function screen and the movable arms as a wireless watch charger as shown in Figure 6. Additionally, the pocket of the “Cara Melayu” serves as a wireless phone charger.

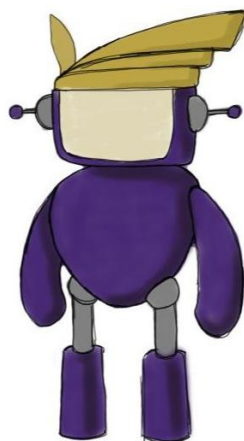


Fig. 6. Concept 6

4.2 Concept Selection

The Pugh method is an effective industrial design evaluation tool for comparing multiple concepts objectively [13].

By using Pugh method, we were able to determine the main base for the final design as shown in Table 2.

Table 2
Pugh method

Criteria	Concept 3	Concept 6
Aesthetic	2	2
Functionality	2	2
UTB Related	1	2
MIB Related	2	1
Creativity	2	1
Total	9	8

From the Pugh table, the chosen design is Concept 3. It is then combined with AJ mascot features. Hence, it will use the Ayer Muleh-inspired form combined with interactive features like a screen and storage compartments.

4.3 Detailed Design

Figure 7 shows the rendered final design, while Table 3 shows the criteria of the final product sculpture.



Fig. 7. Rendered CAD Model

Table 3

Final sculpture criteria

Criteria	Description
Functionality	- Has drawers for compartment - Has magnetic "Ayer Muleh" - Has additional compartments on the middle - Has lights
Aesthetic	Incorporating UTB and MIB aspects (AJ and "Ayer Muleh")
Technological Feature	- Display screen - Lights
Sustainability	Although PLA is not fully biodegradable in nature, it aligns with the broader definition of sustainable material practices proposed by the Brundtland Commission [14].
Space Efficiency	Can fit for table top while also providing compartments to save space
Durability and Maintenance	Can withstand regular use without damage
Innovation and Uniqueness	Stands out from existing products in the market

5. Prototype Development

During the prototype development phase, we decided to base the CAD model dimensions on real-world measurements to ensure the sculpture would correctly fit the interactive screen module used for time, date, temperature, and humidity display.

5.1 CAD Model

The dimensions and housing for the compartments and screen were adjusted precisely to match the physical size of the existing hardware as shown in Figure 8. The final measurements of the sculpture are:

- i. Base diameter: 200 mm.
- ii. Height: 450 mm.
- iii. Screen dimensions: 228 mm × 75 mm.

Materials chosen for the CAD model:

- i. PLA plastic for the base and structure to allow lightweight and durable printing.
- ii. Metal mesh inside hollow parts specifically in the Ayer Muleh feature for added magnetic functionality.



Fig. 8. Rendered final model

5.2 Prototype Fabrication

- i. Using 3D printing techniques, the base and structural components were produced.
- ii. Metal components were used to enhance the functionality of the magnetic sections.
- iii. Attention was given to ensuring accurate fitting of the screen and modular drawer compartments.

5.3 Materials and Tools

- i. Plastic: PLA for majority of the parts (3D printed).
- ii. Metal: Mesh for magnetic holding areas and reinforcement.
- iii. Tools Used: 3D printer, assembly adhesives and hand tools for finishing.

5.4 Integrated Features

- i. Drawer compartments for storage.
- ii. Magnetic board areas inspired by Ayer Muleh motifs.
- iii. Display screen showing time, week, date, temperature, and humidity.
- iv. Dual alarm functions (daily and weekend modes).
- v. Lighting modules.

5.5 Prototype Images

Figure 9, Figure 10 and Figure 11 shows the final prototype of the sculpture.



Fig. 9. Final prototype
(isometric view)



Fig. 10. Final prototype
(isometric view)



Fig. 11. Final prototype
(back view)

6. Testing and Evaluation

After prototype fabrication, the sculpture underwent testing to evaluate its functionality, assembly quality, and usability. Several issues were identified during the testing phase.

6.1 Mechanical and Functional Testing

6.1.1 Drawer mechanism

The finishing on the drawer surfaces caused sticking, making it difficult to push or pull the drawers smoothly. This suggests that additional surface finishing or increased clearance should be considered in future iterations.

6.1.2 Screen circuit measurement errors

During assembly, measurement inaccuracies when designing the housing for the interactive screen's circuit board led to difficulties fitting the intended battery power source inside.

As a result, external wiring was required to power the screen, reducing the neatness of the final assembly.

6.1.3 Lighting assembly error

When assembling the Ayer Muleh part of the sculpture, the wire for the light was mistakenly left outside the casing. This caused exposed wiring and affected the visual cleanliness of the sculpture.

6.2 Material and Surface Quality Testing

6.2.1 Surface finish

As the sculpture was produced using 3D printing (PLA plastic), the surfaces had visible layer lines. Attempts were made to smooth the edges; however, the finish could not be perfected further with manual sanding alone, leaving some rough textures on the surface.

7. Conclusion from Testing

The prototype generally met the functional goals (storage, interactive screen, magnetic board, lighting), but several manufacturing and assembly challenges were identified:

- i. Tolerances for moving parts like drawers need improvements to allow seamless usage.
- ii. Internal component fitting must be measured more accurately.
- iii. Assembly procedures, especially wiring, need better planning to ensure right fit.
- iv. Surface finishing needs further treatment for a cleaner, more professional look. Surface finishing is an important aspect of craftsmanship and user perception in functional product design [15].

Future improvements would involve better tolerance control, pre-assembly checks, and advanced post-processing techniques for smoother surfaces.

7.1 Testing and Validation Images

Figures 12, 13 ,14 and 15 show the testing and validation images.



Fig. 12. Exposed wiring after assembling the Ayer Muleh light section

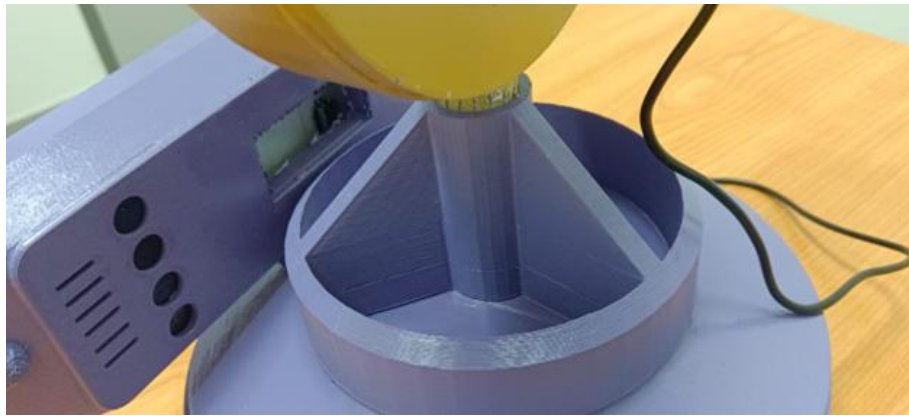


Fig. 13. Remaining surface roughness after manual sanding of 3D printed PLA parts



Fig. 14. Measurement error causing battery compartment to not fit, leading to external power wiring



Fig. 15. Drawer sticking issue due to tight tolerances in 3D printed parts

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